



California Environmental Protection Agency
Department of Pesticide Regulation

Volatile Organic Compound Emissions from Pesticides

March 2005

Randy Segawa

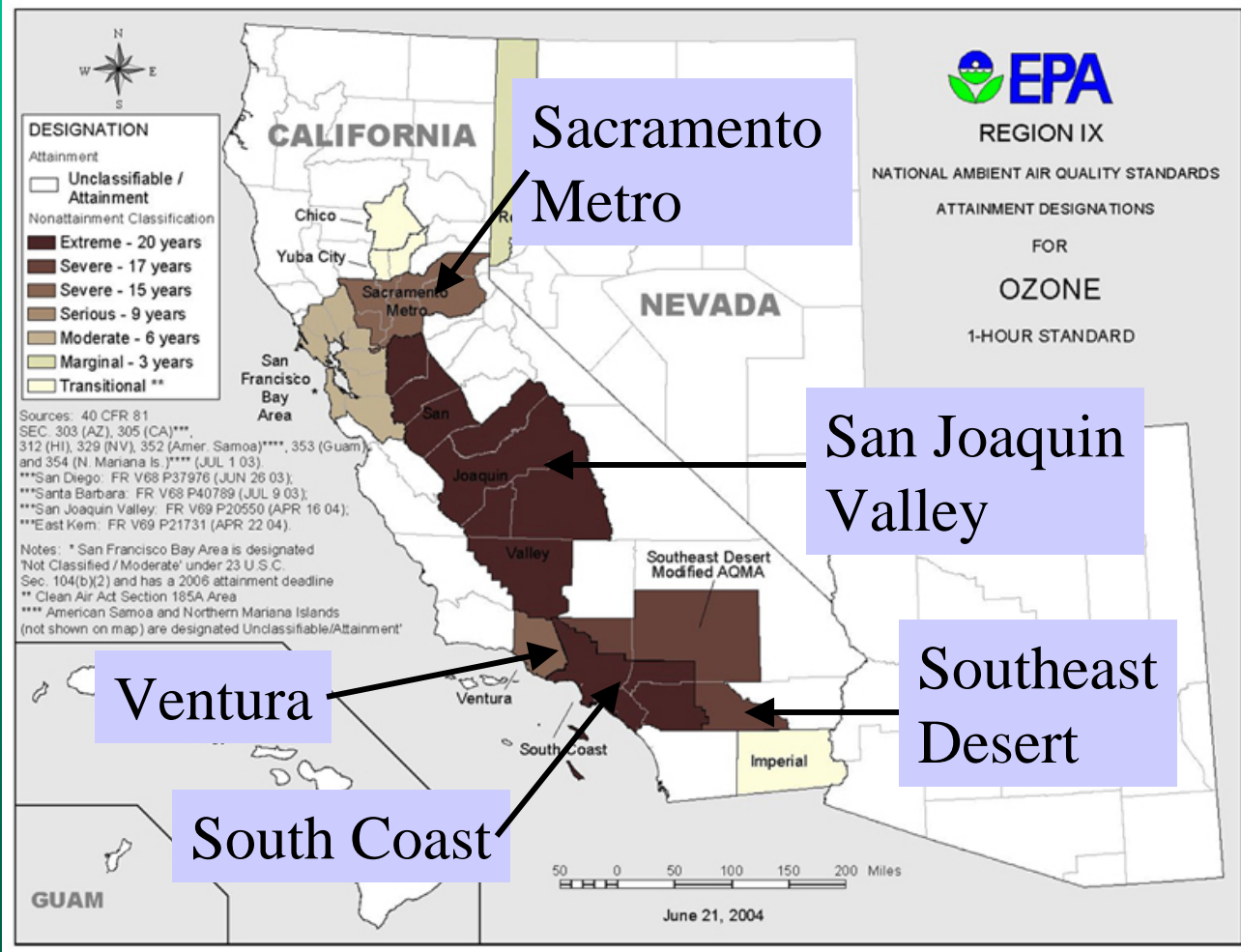


Background

- Volatile organic compounds (VOCs) and nitrogen oxides (NO_x) react with sunlight to form ozone
- Many pesticide active and inert ingredients are VOCs
- As required by the Clean Air Act, Air Resources Board (ARB) and Air Pollution Control Districts (APCD) develop State Implementation Plans (SIP) to reduce VOCs and NO_x
- 1994 SIP requires DPR to reduce pesticide VOC emissions by specified amounts in five nonattainment areas



Ozone Nonattainment Areas Federal 1-hour Standard





1994 SIP Requirements

- Pesticide VOC emissions must be reduced by the following amounts of the 1990 base year:
 - South Coast: 20% by 2010
 - Southeast Desert: 20% by 2007
 - Ventura: 20% by 2005
 - Sacramento Metro: 20% by 2005
 - San Joaquin Valley: 12% by 1999
- If SIP requirements are not met by deadlines:
 - Federal Implementation Plan (FIP) imposed
 - Loss of federal highway funds



Major Sources of VOCs (San Joaquin Valley)

Category	% of 2004 Emissions
LIVESTOCK WASTE (DAIRY CATTLE)	9.6
LIGHT AND MEDIUM DUTY TRUCKS	9.1
LIGHT DUTY PASSENGER CARS	8.3
PRESCRIBED BURNING	7.5
OIL AND GAS PRODUCTION	7.4
PESTICIDES	6.3
CONSUMER PRODUCTS	6.2



Method for Estimating VOCs and Ozone

- DPR estimates VOC emissions from agricultural and commercial structural pesticides
- ARB estimates VOC and NO_x emissions from other sources (including pesticide consumer products)
- ARB uses computer modeling to estimate ozone concentrations based on VOC and NO_x emissions
- ARB verifies and adjusts modeling based on ozone air monitoring data



Method for Estimating Pesticide VOCs

- DPR maintains an inventory of VOC emissions from agricultural and commercial structural applications of pesticide **products**
- VOC emission from a pesticide product is:
emission = VOC fraction in product x amount of product
- VOC fraction (**emission potential**) determined by:
 - Lab test (thermogravimetric analysis, TGA)
 - Water/inorganic subtraction
 - Confidential statement of formula
 - Default value



Estimating Amount of Product

- VOC emission from a pesticide product is:
$$\text{emission} = \text{emission potential} \times \text{amount of product}$$
- Amount of product determined from pesticide use reports (PUR)
- Pesticide use reports contain information on
 - Product applied
 - Amount applied
 - Date of application
 - Location of application
 - Commodity or site treated



Emission Inventory Calculations

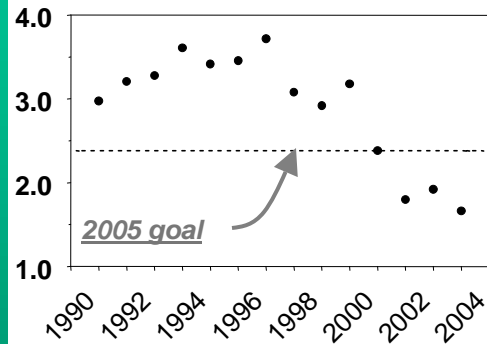
- Using emission potential estimates and pesticide use report data, DPR calculates VOC emissions from agricultural and commercial structural applications for all years beginning with 1990
- DPR updates each year of inventory annually based on most recent PUR and emission potential data
- Inventory focuses on:
 - May – Oct (peak ozone period) for each year
 - 5 nonattainment areas

1990 - 2003 May - October Pesticide VOC Emissions

NAA 1

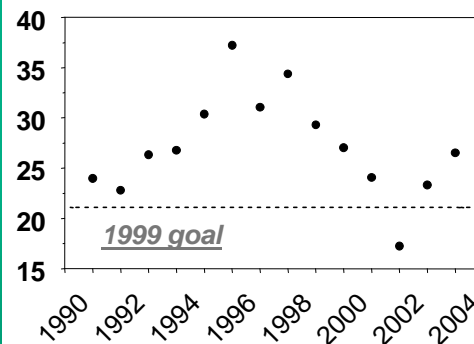
Sacramento Metropolitan Area

emissions (tons/day)



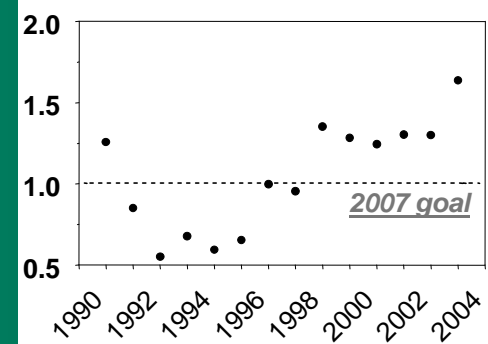
NAA 2

San Joaquin Valley



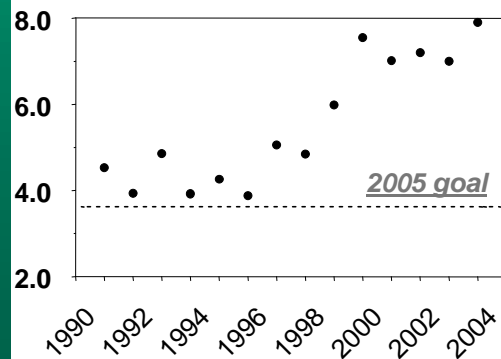
NAA 3

Southeast Desert

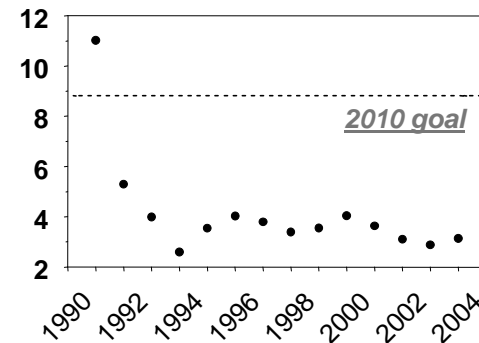


NAA 4
Ventura

emissions (tons/day)



NAA 5
South Coast





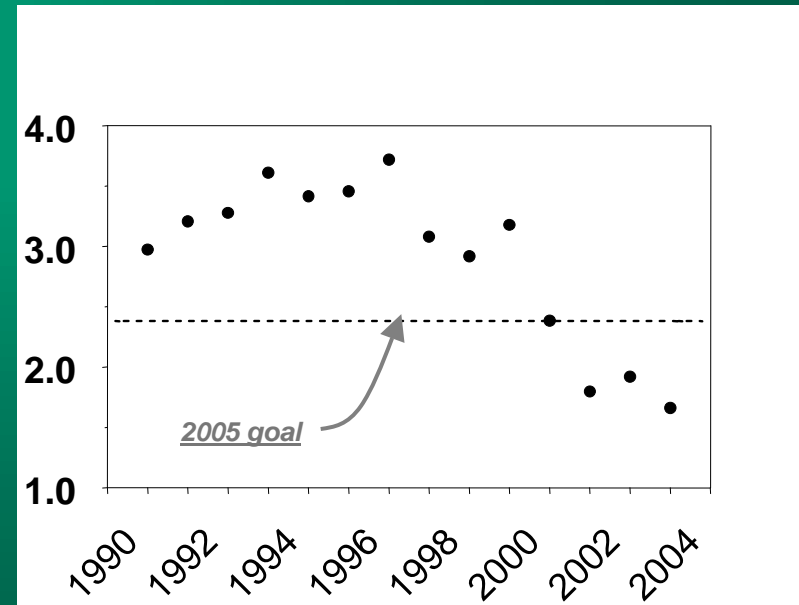
Pesticide Emission Characteristics

- VOC emission patterns parallel pesticide use
- More than 90% of emissions from ag sources, except South Coast
- Fumigants are high contributors in all areas
- Emulsifiable concentrates are high contributors



2003 Pesticide VOC Emissions in Sacramento Metro Nonattainment Area

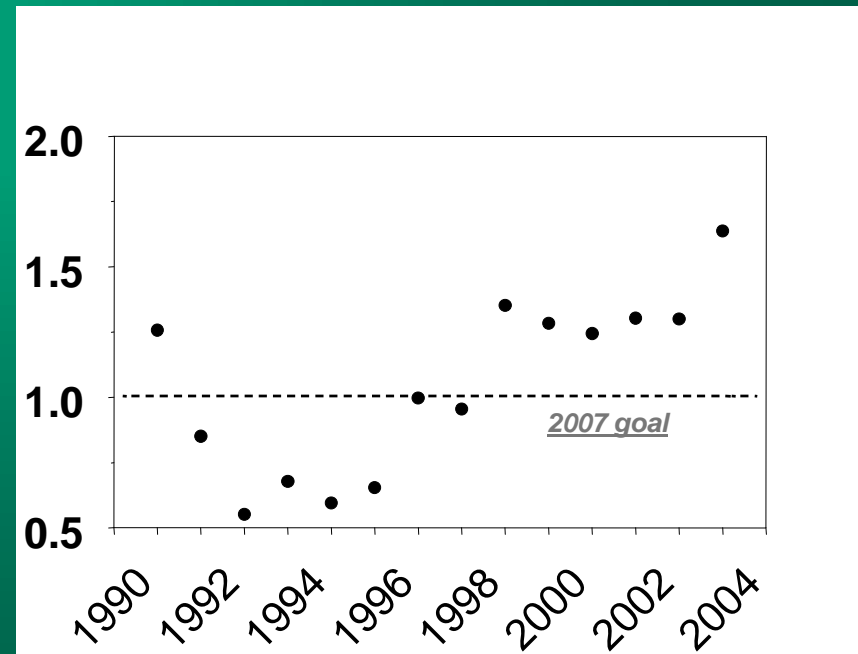
- Top “Primary” Active Ingredients (% of emissions)
 - Molinate (23%)
 - 1,3-Dichloropropene (10%)
 - Chlorpyrifos (6%)
 - Methyl bromide (6%)
- Top Application Sites
 - Rice (32%)
 - Walnuts (10%)
 - Tomatoes (9%)
 - Structural pest control (8%)





2003 Pesticide VOC Emissions in Southeast Desert Nonattainment Area

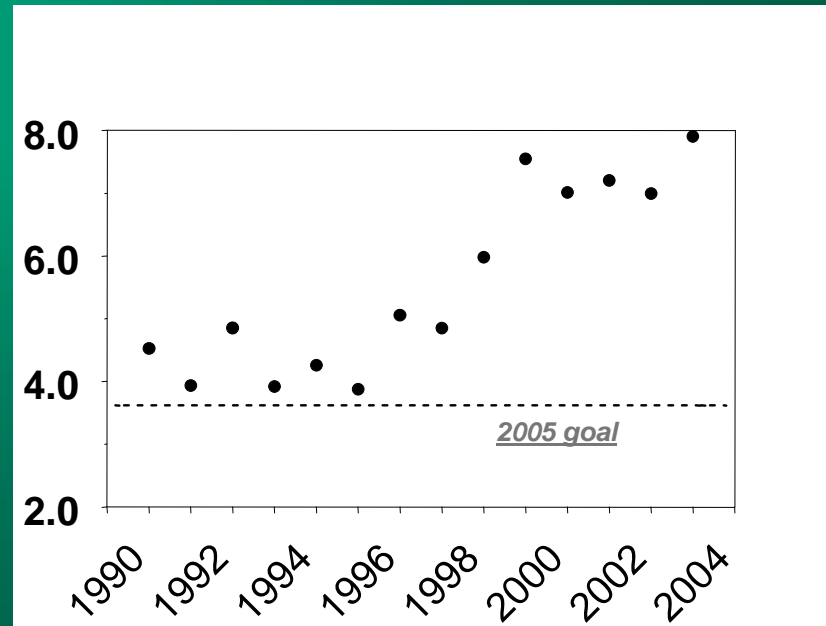
- Top “Primary” Active Ingredients (% of emissions)
 - Metam-sodium (49%)
 - Methyl bromide (17%)
 - Metam-potassium (7%)
 - Glyphosate (6%)
- Top Application Sites
 - Carrots (15%)
 - Peppers (15%)
 - Strawberries (13%)
 - Uncultivated ag (11%)





2003 Pesticide VOC Emissions in Ventura Nonattainment Area

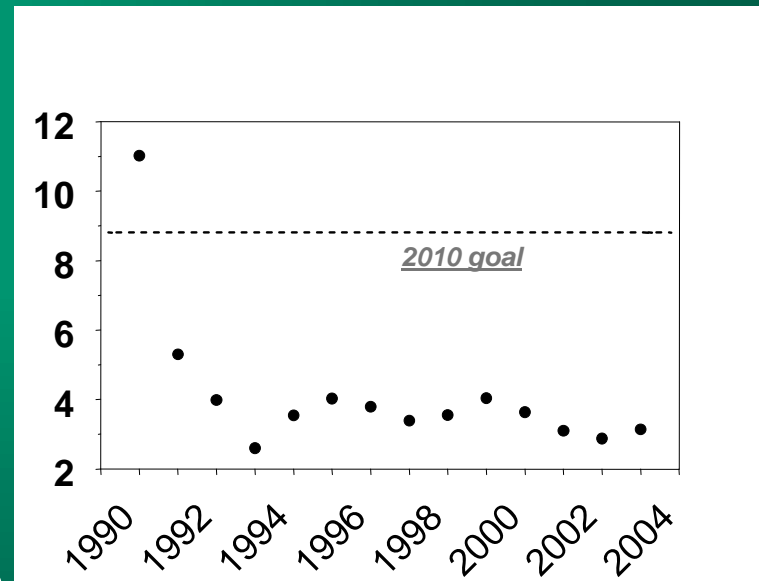
- Top “Primary” Active Ingredients (% of emissions)
 - Methyl bromide (76%)
 - 1,3-dichloropropene (8%)
 - Metam-sodium (5%)
 - Chloropicrin (3%)
- Top Application Sites
 - Strawberries (83%)
 - Lemons (4%)
 - Tomatoes (3%)
 - Raspberries (2%)





2003 Pesticide VOC Emissions in South Coast Nonattainment Area

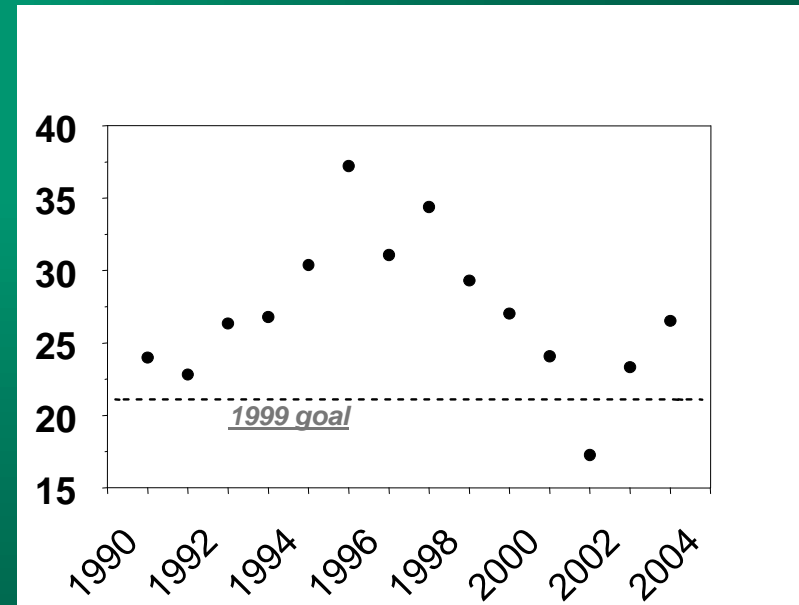
- Top “Primary” Active Ingredients (% of emissions)
 - Methyl bromide (38%)
 - Chloropicrin (15%)
 - Permethrin (11%)
 - Glyphosate (5%)
- Top Application Sites
 - Strawberries (40%)
 - Structural pest control (26%)
 - Fumigation, other (9%)
 - Landscape maintenance (6%)





2003 Pesticide VOC Emissions in San Joaquin Valley Nonattainment Area

- Top “Primary” Active Ingredients (% of emissions)
 - Metam-sodium (22%)
 - 1,3-Dichloropropene (15%)
 - Methyl bromide (11%)
 - Chlorpyrifos (9%)
- Top Application Sites
 - Carrots (18%)
 - Cotton (13%)
 - Almonds (12%)
 - Nursery-outdoor (5%)





Key Regulatory and Legal Issues

- Environmental groups are suing DPR and ARB about 1994 SIP
- DPR is no longer in compliance with pesticide SIP for San Joaquin Valley
- Even if in compliance, San Joaquin Valley needs approx 30% additional VOC reduction from all sources to achieve 1-hr ozone standard
- In April 2004, U.S. EPA issued a more stringent 8-hr standard for ozone



Difficulty in Achieving Ozone Standard

Approximately 30% VOC reduction of all sources needed to achieve 1-hour ozone standard in San Joaquin Valley

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Current and Future Activities – Research Needs

- Emission Inventory Research
 - Field emissions of VOCs
 - Speciation and reactivity (ARB funding)
- Emission Reduction Research
 - IPM (UC possible)
 - Formulation changes and new pesticides
 - Application method changes, particularly fumigants (ARB funding)
 - Application rate reductions
 - Temporal changes



Current and Future Activities – Regulatory Actions

- Due to 1994 SIP requirements, DPR cannot wait until research completed to implement regulatory measures
- DPR will require emission potential (TGA) data
 - Reevaluation for ~800 current products
 - Registration requirement for new products
- DPR will initiate a separate reevaluation to require reformulation of certain products
 - Establish a VOC limit
 - Primarily impacts emulsifiable concentrates



Summary of Key Points

- DPR estimates VOC emissions based on VOC content and use of pesticide products
- DPR no longer in compliance with 1994 pesticide SIP for San Joaquin Valley
- Additional VOC reductions likely needed to meet new 8-hr ozone standard
- ARB and others are conducting research
- DPR initiating regulatory actions to increase accuracy of emission estimates and reduce VOC emissions



Questions/Additional Information

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Programs and Services

Volatile Organic Compounds Emissions Project